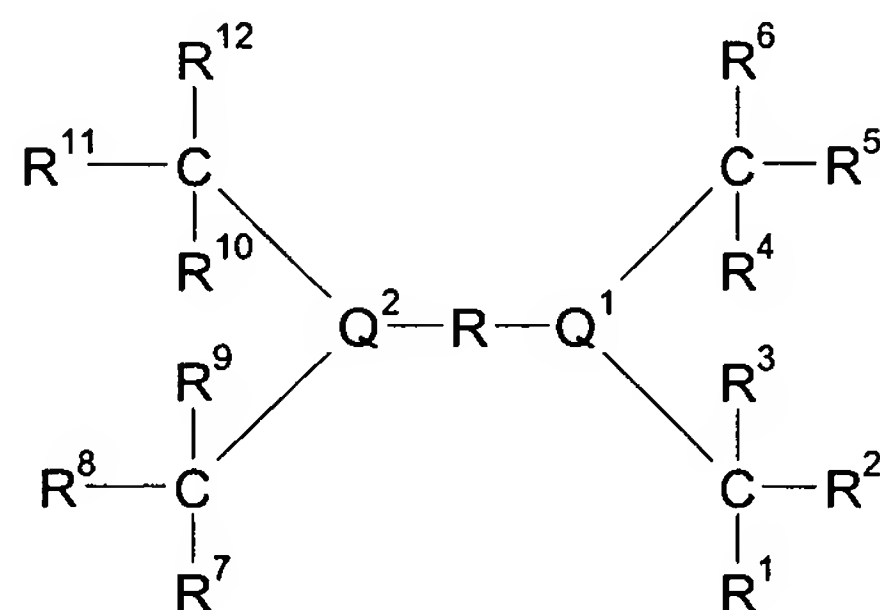


AMENDMENTS TO THE CLAIMS

Claim 1. (Original) A process for the hydroformylation of ethylenically unsaturated compounds, which process comprises reacting said ethylenically unsaturated compound with carbon monoxide and hydrogen, in the presence of a catalyst system, the catalyst system obtainable by combining:

- a) a Group VIII metal compound; and
- b) a bidentate phosphine of general formula (Ia)

(Ia)



wherein:

R is a bridging group;

R¹ to R¹² each independently represent hydrogen, lower alkyl, aryl or Het, preferably, lower alkyl, aryl or Het;

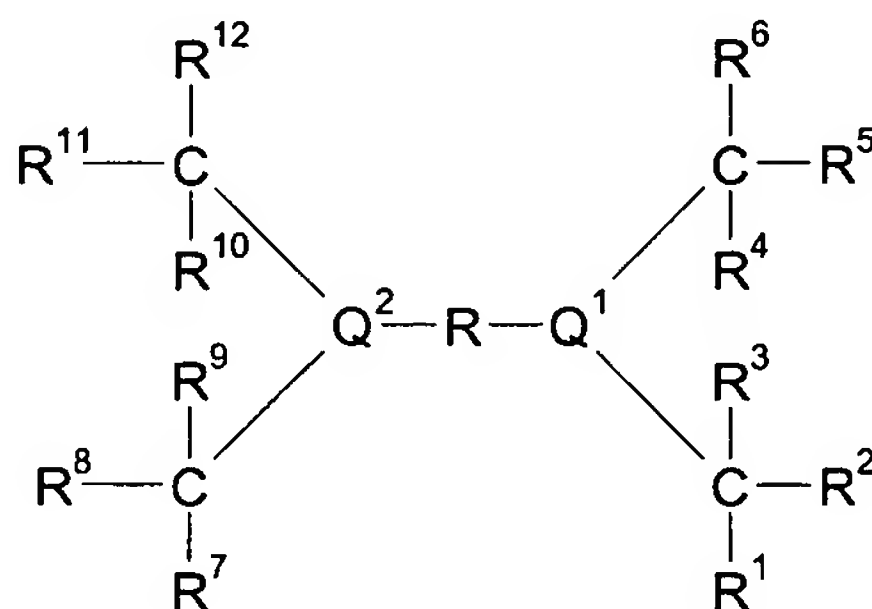
Q¹ and Q² each independently represent phosphorus, arsenic or antimony and in the latter two cases references to phosphine or phosphorus above are amended accordingly,

the process characterised in that a chlorine moiety is present in at least said Group VIII metal compound.

Claim 2. (Original) A process for the hydroformylation of ethylenically unsaturated compounds, which process comprises reacting said ethylenically unsaturated compound with carbon monoxide and hydrogen, in the presence of a catalyst system and a solvent, the catalyst system obtainable by combining:

- a) a metal of Group VIII or a compound thereof; and
- b) a bidentate phosphine of general formula (Ia)

(Ia)



wherein:

R is a bridging group;

R^1 to R^{12} each independently represent hydrogen, lower alkyl, aryl or Het, preferably, lower alkyl, aryl or Het;

Q^1 and Q^2 each independently represent phosphorus, arsenic or antimony and in the latter two cases references to phosphine or phosphorus above are amended accordingly,

the process characterised in that a chlorine moiety is present in at least one of the said Group VIII metal compound or said solvent.

Claim 3. (Original) The process as claimed in claim 2, wherein a chlorine moiety is present in both said Group VIII metal compound and said solvent.

Claim 4. (Currently Amended) The process as claimed in ~~any of claims 1 to 3~~ claim 1, wherein R^1 to R^{12} each independently represent C_1 to C_6 alkyl, C_1 to C_6 alkyl phenyl or phenyl.

Claim 5. (Original) The process as claimed in claim 4, wherein R^1 to R^{12} each independently represent methyl, ethyl, n-propyl, iso-propyl, n-butyl, iso-butyl, tert-butyl, pentyl, hexyl and cyclohexyl.

Claim 6. (Currently Amended) The process as claimed in ~~any preceding claim~~ claim 1, wherein R^1 , R^4 , R^7 and R^{10} each independently represent the same C_1 - C_6 alkyl; R^2 , R^5 , R^8 and R^{11} , each independently represent the same C_{1-6} alkyl; and R^3 , R^6 , R^9 and R^{12} , each independently represent the same C_{1-6} alkyl.

Claim 7. (Currently Amended) The process as claimed in ~~any preceding claim~~ claim 1, wherein R^1 to R^{12} each represents the same C_1 - C_6 alkyl group.

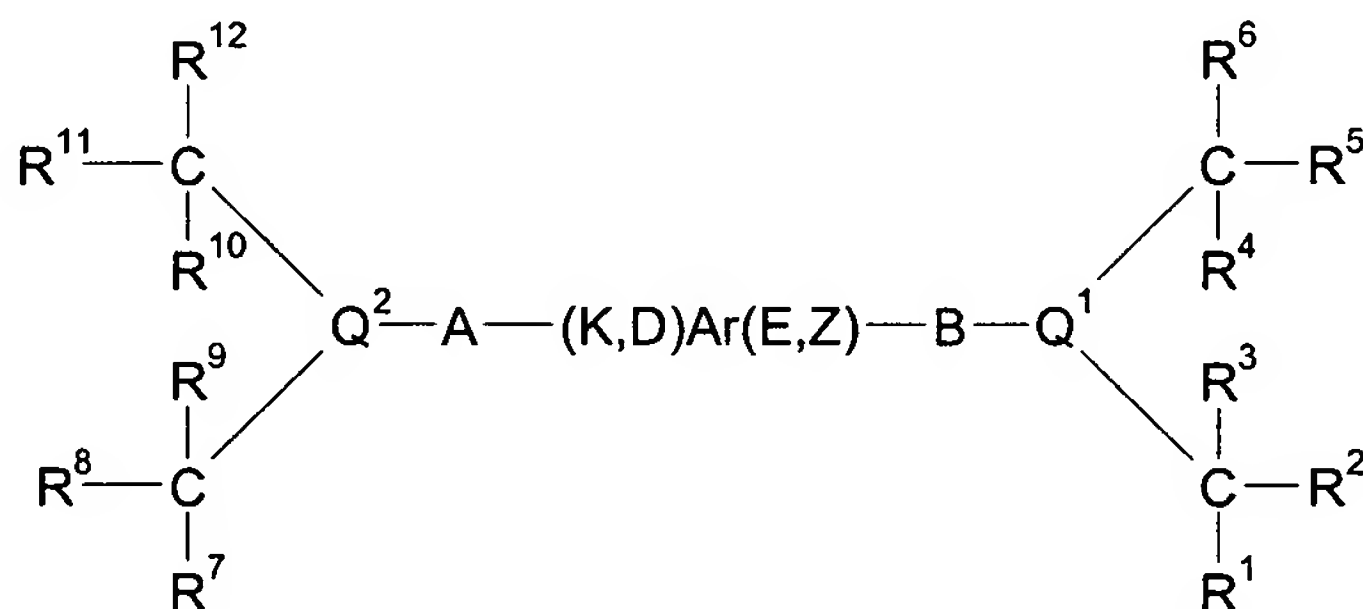
Claim 8. (Original) The process as claimed in claim 7, wherein the said C_{1-6} alkyl group is non-substituted and selected from the list comprising: methyl, ethyl, n-propyl, iso-propyl, n-butyl, iso-butyl, tert-butyl, pentyl, hexyl and cyclohexyl.

Claim 9. (Original) The process as claimed in claim 8, wherein the said C_{1-6} alkyl group is methyl.

Claim 10. (Currently Amended) The process as claimed in ~~any preceding claim~~ claim 1, wherein Q^1 and Q^2 represents phosphorus.

Claim 11. (Currently Amended) The process as claimed in ~~any one of claims 1 to 3~~ claim 1 wherein R is defined as $-A-(K,D)Ar(E,Z)-B-$ and the bidentate phosphine is of general formula (I)

(I)



wherein:

Ar is a bridging group comprising an optionally substituted aryl moiety to which the phosphorus atoms are linked on available adjacent carbon atoms;

A and B each independently represent lower alkylene;

K, D, E and Z are substituents of the aryl moiety (Ar) and each independently represent hydrogen, lower alkyl, aryl, Het, halo, cyano, nitro, OR^{19} , $OC(O)R^{20}$, $C(O)R^{21}$, $C(O)OR^{22}$, $NR^{23}R^{24}$, $C(O)NR^{25}R^{26}$, $C(S)R^{25}R^{26}$, SR^{27} , $C(O)SR^{27}$, or $-J-Q^3(CR^{13}(R^{14})(R^{15}))CR^{16}(R^{17})(R^{18})$ where J represents lower alkylene; or two adjacent groups selected from K, Z, D and E together with the carbon atoms of the aryl ring to which they are attached form a further phenyl ring, which is optionally substituted by one or more substituents selected from hydrogen, lower alkyl, halo, cyano,

nitro, OR¹⁹, OC(O)R²⁰, C(O)R²¹, C(O)OR²², NR²³R²⁴, C(O)NR²⁵R²⁶, C(S)R²⁵R²⁶, SR²⁷ or C(O)SR²⁷;

R¹ to R¹⁸ each independently represent lower alkyl, aryl, or Het;

R¹⁹ to R²⁷ each independently represent hydrogen, lower alkyl, aryl or Het;

Q¹, Q² and Q³ (when present) each independently represent phosphorous, arsenic or antimony and in the latter two cases references to phosphine or phosphorous above are amended accordingly.

Claim 12. (Original) The process as claimed in claim 11, wherein R¹ to R¹⁸ each independently represent C₁ to C₆ alkyl, C₁ to C₆ alkyl phenyl or phenyl.

Claim 13. (Original) The process as claimed in claim 12, wherein R¹ to R¹⁸ each independently represent methyl, ethyl, n-propyl, iso-propyl, n-butyl, iso-butyl, tert-butyl, pentyl, hexyl and cyclohexyl.

Claim 14. (Currently Amended) The process as claimed in ~~any of claims 11 to 13~~ claim 11 wherein R¹, R⁴, R⁷, R¹⁰, R¹³ and R¹⁶ each independently represent the same C₁-C₆ alkyl; R², R⁵, R⁸, R¹¹, R¹⁴ and R¹⁷ each independently represent the same C₁₋₆ alkyl; and R³, R⁶, R⁹, R¹², R¹⁵ and R¹⁸ each independently represent the same C₁₋₆ alkyl.

Claim 15. (Currently Amended) The process as claimed in ~~any of claims 11 to 14~~ claim 11, wherein R¹ to R¹⁸ each represents the same C₁-C₆ alkyl group.

Claim 16. (Original) The process as claimed in claim 15, wherein the said C₁₋₆ alkyl group is non-substituted and selected from the list comprising: methyl, ethyl, n-propyl, iso-propyl, n-butyl, iso-butyl, tert-butyl, pentyl, hexyl and cyclohexyl.

Claim 17. (Original) The process as claimed in claim 16, wherein the said C₁₋₆ alkyl group is methyl.

Claim 18. (Currently Amended) The process as claimed in ~~any of claims 11 to 17~~ claim 11, wherein Q¹, Q² and Q³ (when present) represents phosphorus.

Claim 19. (Currently Amended) The process as claimed in ~~any of claims 11 to 18~~ claim 11, wherein A, B and J (when present) each independently represent C₁ to C₆ alkylene.

Claim 20. (Original) The process as claimed in claim 19, wherein each of A, B and J (when present) represent -CH₂-.

Claim 21. (Currently Amended) The process as claimed in ~~any of claims 11 to 20~~ claim 11, wherein K, D, E and Z each represent hydrogen, phenyl, C₁-C₆ alkylphenyl or C₁-C₆ alkyl.

Claim 22. (Original) The process as claimed in claim 21, wherein K, D, E and Z each represent hydrogen.

Claim 23. (Original) The process as claimed in claim 11 wherein in formula (I):

A and B each independently represent unsubstituted C₁ to C₆ alkylene;

K, D, Z and E each independently represent hydrogen, C₁-C₆ alkyl, phenyl, C₁-C₆ alkylphenyl or -J-Q³(CR¹³(R¹⁴)(R¹⁵))CR¹⁶(R¹⁷)(R¹⁸) where J represents unsubstituted C₁ to C₆ alkylene; or two of K, D, Z and E together with the carbon atoms of the aryl ring to which they are attached form a phenyl ring which is optionally substituted by one or more substituents selected from lower alkyl, phenyl or lower alkylphenyl;

R¹ to R¹⁸ each independently represent C₁ to C₆ alkyl, phenyl or C₁ to C₆ alkylphenyl.

Claim 24. (Original) The process as claimed in claim 11 wherein in formula (I):

A and B both represent $-\text{CH}_2-$ or C_2H_4 ;

K, D, Z and E each independently represent hydrogen, C_1 - C_6 alkyl phenyl or C_1 - C_6 alkyl or -J- $\text{Q}^3(\text{CR}^{13}(\text{R}^{14})(\text{R}^{15}))\text{CR}^{16}(\text{R}^{17})(\text{R}^{18})$ where J is the same as A; or two of K, D, E and Z together with the carbon atoms of the aryl ring to which they are attached form an unsubstituted phenyl ring;

R^1 to R^{18} each independently represent C_1 to C_6 alkyl;

Claim 25. (Original) The process as claimed in claim 24, wherein A and B both represent $-\text{CH}_2-$.

Claim 26. (Original) The process as claimed in claim 11, wherein in formula (I):
each R^1 to R^{12} is the same and represents methyl;
A and B are the same and represent $-\text{CH}_2-$;
K, D, Z and E are the same and represent hydrogen.

Claim 27. (Currently Amended) The process as claimed in ~~any of claims 11 to 26~~ claim 11, wherein the reaction is carried out at a temperature of between 20°C and 180°C .

Claim 28. (Original) The process as claimed in claim 27, wherein the temperature is in the range 50°C to 150°C .

Claim 29. (Currently Amended) The process as claimed in ~~any of claims 11 to 28~~ claim 11, wherein the reaction is carried out under a partial pressure of carbon monoxide/hydrogen in the range of 1 to 700 bar.

Claim 30. (Original) The process as claimed in claim 29, wherein the partial pressure is in the range 1 to 300 bar.

Claim 31. (Currently Amended) The process as claimed in ~~any of claims 11 to 30~~ claim 11, wherein said ethylenically unsaturated compound has 1 to 3 carbon-carbon double bonds per molecule.

Claim 32. (Original) The process as claimed in claim 31, wherein said compound has 1 carbon-carbon double bond per molecule.

Claim 33. (Currently Amended) The process as claimed in ~~any of claims 11 to 32~~ claim 11, wherein the amount of bidentate compound of formula (I) to unsaturated compound is in the range 10^{-5} to 10^{-2} moles per mole of unsaturated compound.

Claim 34. (Currently Amended) The process as claimed in ~~any of claims 11 to 33~~ claim 11, wherein said catalyst system further comprises a support.

Claim 35. (Currently Amended) The process as claimed in ~~any of claims 11 to 34~~ claim 11, wherein said bidentate phosphine is selected from the group comprising bis (di-*t*-butyl phosphino)-*o*-xylene; 1,2 bis (diadamantylphosphinomethyl) benzene; 1,2 bis (diadamantylphosphinomethyl) naphthalene; 1,2 bis (di-*t*-pentyl phosphino)-*o*-xylene; and bis 1,2 (di-*t*-butyl phosphino) naphthalene.

Claim 36. (Currently Amended) The process as claimed in ~~any of claims 11 to 35~~ claim 11, wherein the mol:mol range of compounds of formula (I) to Group VIII metal is in the range of 1:1 to 3:1.

Claim 37. (Original) The process as claimed in claim 36, wherein said mol:mol range is in the range of 1:1 to 1.25:1.

Claim 38. (Currently Amended) The process as claimed in ~~any of claims 11 to 37~~ claim 11, wherein the Group VIII metal is selected from the group: cobalt, nickel, palladium, rhodium, ruthenium and platinum.

Claim 39. (Original) The process as claimed in claim 38, wherein said Group VIII metal is rhodium.

Claim 40. (Currently Amended) The process as claimed in ~~any of claims 11 to 39~~ claim 11, wherein said chlorine moiety is present in at least said Group VIII metal compound and said compound is selected from the group comprising: $[\text{RhCl}(\text{CO})_2]_2$, $[\text{RhCl}(\text{Cod})_2]_2$, $\text{RhCl}_3 \cdot x\text{H}_2\text{O}$, $[\text{RhCl}(\text{Norbornadiene})]_2$, $[\text{RhCl}(\text{Cyclooctene})_2]_2$, Chloro(1,5-hexadiene)-rhodium(I)dimer, μ -dichlorotetraethylene-dirhodium, (bicyclo[2,2,1]hepta-2-5-diene)chlororhodium(I)dimer.

Claim 41. (Currently Amended) The process as claimed in ~~any of claims 11 to 40~~ claim 11, wherein said chlorine moiety is present in at least said Group VIII metal compound and said compound is selected from the group comprising: $[\text{RhCl}(\text{CO})_2]_2$, $[\text{RhCl}(\text{Cod})_2]_2$ and $\text{RhCl}_3 \cdot x\text{H}_2\text{O}$.

Claim 42. (Currently Amended) The process as claimed in ~~any of claims 11 to 41~~ claim 11, wherein said chlorine moiety is present in at least said solvent and said solvent is selected from the group comprising dichloromethane, chlorobenzene, o-dichlorobenzene, m-chlorobenzene, carbon tetrachloride, trichloroethanes, dichloroethanes, chlorofluorocarbons (CFC's), tetrachloroethanes and tetrachloroethene.

Claim 43. (Original) The process as claimed in claim 42, wherein said solvent is dichloromethane.

Claim 44. (Currently Amended) The process as claimed in ~~any of claims 11 to 43~~ claim 11, wherein said ethylenically unsaturated compound has 2 to 20 carbon atoms.

Claim 45. (Original) The process as claimed in claim 44, wherein said compound has 5 to 15 carbon atoms.

Claim 46. (Original) The process as claimed in claim 44, wherein said compound has 6 to 12 carbon atoms.

Claim 47. (Currently Amended) The process as claimed in ~~any of claims 11 to 46~~ claim 11, wherein said ethylenically unsaturated compound is selected from the group comprising ethene, propene, 1-butene, 2-butene, isobutene, 1-pentene, 2-pentene, 3-pentene and branched isomers thereof, 1-hexene and its isomers, 1-heptene and its isomers, 1-octene and its isomers, 1-nonene and its isomers, 1-decene and its isomers, the C₁₁-C₂₀ alkenes and their known isomers, 3-pentenitrile, methyl-3-penteneoate, 1,3 butadiene, 1,3-pentadiene, 1,3 hexadiene, 1,3 cyclohexadiene, 2,4-leptadiene, and 2-methyl 1,3 butadiene.

Claim 48. (Currently Amended) The process as claimed in ~~any of claims 11 to 47~~ claim 11, wherein the said catalyst system further comprises a polymeric dispersant dissolved in a liquid carrier, said polymeric dispersant being capable of stabilising a colloidal suspension of particles of the Group VIII metal or metal compound of the catalyst system within the said liquid carrier.

Claim 49. (Original) The process as claimed in claim 48, wherein said polymeric dispersant is selected from the list comprising: polyvinylpyrrolidone, polyacrylamide, polyacrylonitrile, polyethylenimine, polyglycine, polyacrylic acid, polymethacrylic acid, poly(3-hydroxybutyric acid), poly-L-leucine, poly-L-methionine, poly-L-proline, poly-L-serine, poly-L-tyrosine, poly(vinylbenzenesulphonic acid) and poly(vinylsulphonic acid).

Claim 50. (Original) The process as claimed in claim 49, wherein said polymeric dispersant is selected from the list comprising: polyvinylpyrrolidone and polyacrylic acid.

Claim 51. (Currently Amended) The process as claimed in ~~any of claims 11 to 50~~ claim 11, wherein the solvent is formed by one or more of the reactants, products or by-products of the process rather than being a separate entity.

Claim 52. (Currently Amended) A process as claimed in ~~any of claims 11 to 51~~ claim 11, wherein Ar is defined as including six-to-ten-membered carbocyclic aromatic groups, such as phenyl and naphthyl, which groups are optionally substituted with, in addition to K, D, E or Z, one or more substituents selected from aryl, lower alkyl, Het, halo, cyano, nitro, OR^{19} , $OC(O)R^{20}$, $C(O)R^{21}$, $C(O)OR^{22}$, $NR^{23}R^{24}$, $C(O)NR^{25}R^{26}$, SR^{27} , $C(O)SR^{27}$ or $C(S)NR^{25}R^{26}$ wherein R^{19} to R^{27} each independently represent hydrogen, aryl or lower alkyl.

Claim 53. (Currently Amended) A process as claimed in ~~any preceding claim~~ claim 1 wherein at least one $(CR^xR^yR^z)$ group attached to Q^1 and/or Q^2 , i.e. $CR^1R^2R^3$, $CR^4R^5R^6$, $CR^7R^8R^9$, or $CR^{10}R^{11}R^{12}$, may instead be congressyl or adamantyl, or both groups defined above as $(CR^xR^yR^z)$ attached to either or both Q^1 and/or Q^2 , may, together with either Q^1 or Q^2 as appropriate, instead form an optionally substituted 2-phospha-tricyclo[3.3.1.1^{3,7}]decyl group or derivative thereof.

Claim 54. (Currently Amended) A process as claimed in ~~any of claims 11 to 51 and 53~~ claim 11, wherein Ar is a cyclopentadienyl group, and Z may be represented by $-M(L_1)_n(L_2)_m$ and Z is connected via a metal ligand bond to the cyclopentadienyl group, M represents a Group VIB or VIIIB metal or metal cation thereof; and

L_1 represents a cyclopentadienyl, indenyl or aryl group each of which groups are optionally substituted by one or more substituents selected from hydrogen, lower alkyl, halo, cyano, nitro, OR^{19} , $OC(O)R^{20}$, $C(O)R^{21}$, $C(O)OR^{22}$, $NR^{23}R^{24}$, $C(O)NR^{25}R^{26}$, $C(S)R^{25}R^{26}$, SR^{27} , $C(O)SR^{27}$ or ferrocenyl;

L_2 represents one or more ligands each of which are independently selected from hydrogen, lower alkyl, alkylaryl, halo, CO, $PR^{43}R^{44}R^{45}$ or $NR^{46}R^{47}R^{48}$;

R^{43} to R^{48} each independently represent hydrogen, lower alkyl, aryl or Het;

$n = 0$ or 1 ;

and $m = 0$ to 5 ;

provided that when $n = 1$ then m equals 0 , and when n equals 0 then m does not equal 0 .

Claim 55. (Currently Amended) A process as claimed in ~~any of claims 1 to 10~~ claim 1, wherein R represents an alkylene bridging group, preferably, a lower alkylene.

Claim 56. (Original) A process for the hydroformylation of ethylenically unsaturated compounds as described hereinbefore with reference to the examples herein.

Claim 57. (Currently Amended) A catalyst system, preferably wherein said system is for use in a process for the hydroformylation of ethylenically unsaturated compounds and which process comprises reacting said ethylenically unsaturated compound with carbon monoxide and hydrogen, in the presence of said system, the catalyst system obtainable by combining:

a) a Group VIII metal compound as defined in ~~any preceding claim~~ claim 1; and

b) a bidentate phosphine as defined in any preceding claim,

and wherein the catalyst system is characterised in that a chlorine moiety is present in at least said Group VIII metal compound.

Claim 58. (Currently Amended) A hydroformylation reaction catalyst system for the catalysis of ethylenically unsaturated compounds with carbon monoxide and hydrogen in the presence of said system, the catalyst system obtainable by combining:

- a) a Group VIII metal compound as defined in ~~any preceding claim~~ claim 1; and
- b) a bidentate phosphine as defined in any preceding claim,

and wherein the catalyst system is characterised in that a chlorine moiety is present in at least said Group VIII metal compound.

Claim 59. (Currently Amended) A reaction medium comprising a catalyst system and a solvent, preferably wherein said medium is for use in a process for the hydroformylation of ethylenically unsaturated compounds and which process comprises reacting said ethylenically unsaturated compound with carbon monoxide and hydrogen, in the presence of said system and said solvent, wherein said solvent is as defined in any preceding claim, the catalyst system obtainable by combining:

- a) a metal of Group VIII or a compound thereof as defined in ~~any preceding claim~~ claim 1; and
- b) a bidentate phosphine as defined in any preceding claim,

and wherein the reaction medium is characterised in that a chlorine moiety is present in at least one of the said Group VIII metal compound or said solvent, including the possibility of being present in both.

Claim 60. (Currently Amended) A hydroformylation reaction medium, wherein said medium comprises a catalyst system and a solvent, preferably wherein said system is for use in a process for the hydroformylation of ethylenically unsaturated compounds and which process comprises reacting said ethylenically unsaturated compound with carbon monoxide and hydrogen, in the presence of said system and said solvent, wherein said solvent is as defined in ~~any preceding claim~~ claim 1, the catalyst system obtainable by combining:

- a) a metal of Group VIII or a compound thereof as defined in any preceding claim; and

b) a bidentate phosphine as defined in any preceding claim,
and wherein the reaction medium is characterised in that a chlorine moiety is present in at least one of the said Group VIII metal compound or said solvent, including the possibility of being present in both.

Claim 61. (Currently Amended) The use of a catalyst system as defined in ~~any preceding claim~~ claim 1 for the hydroformylation of ethylenically unsaturated compounds, said use comprising the step of reacting said ethylenically unsaturated compound with carbon monoxide and hydrogen, in the presence of said catalyst system.

Claim 62. (Currently Amended) The use of a reaction medium as defined in ~~any preceding claim~~ claim 1 for the hydroformylation of ethylenically unsaturated compounds, said use comprising the step of reacting said ethylenically unsaturated compound with carbon monoxide and hydrogen, in the presence of said reaction medium.